Fused Intent Systems (FIS); Dynamic Adversarial Gaming (DAGA)

18-19 March 2008

Behavioral Influences Analysis (BIA) Center's

annual Tools/Computational Approaches/Methods Conference

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Fused Intent System (FIS)

Program Overview

- *Customer: Office of Naval Research*
- *Contract Duration: Year 2 of 3*
- *ONR Focus Area*
  - *Level 2 / Level 3 Information Fusion –*
    - *Inference Engines, Abductive Engines – transform level 0/1 data into level 2/3 knowledge through the use of inference and abductive reasoning.*

Operational Need

*"What passes for intelligence today is often merely the **reporting of information**: analysts looking at an unfolding event and explaining what is happening."*

Commander Jason Hines, Deputy Director for Intelligence, U.S. Pacific Fleet, Naval Institute Proceedings, Feb 2005

- There is currently a lack of tools to support understanding the ***intent*** of the adversary regarding observed events in the operational environment (i.e. why).

- Without understanding ***intent*** it is impossible to ***understand*** the adversary's behavior and ***predict*** their next course of action.

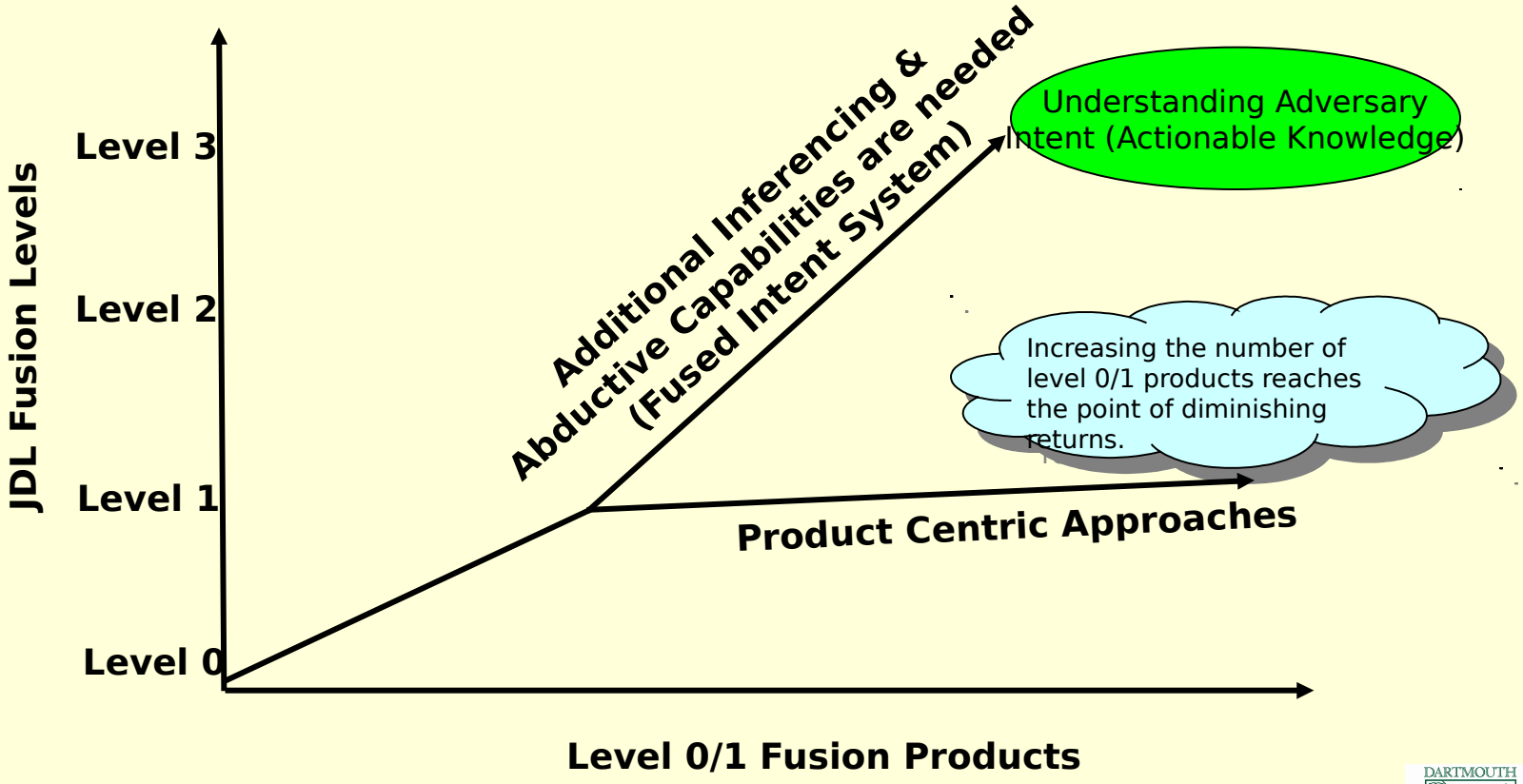
Operational Need

- **Understanding *intent* requires inferring knowledge based on complex relationships among observable activities and adversary beliefs and goals.**

- **Current intelligence tools and processes are**
  - Reactionary, with little to no predictive capabilities
  - Not able to observe/quantify intent directly
  - Manually intensive and subjective resulting in inconsistencies between analysts and inaccuracies in understanding
  - Focused on level 1 fusion, which does not explain complex relationships needed for actionable intelligence.
  - Do not provide Commanders timely means to explore alternative hypotheses and perform ‘what-if’ scenarios.
  - Do not operate in a net-centric manner, resulting in stovepiped knowledge.

Operational Need

Limitations of Product Centric Approaches



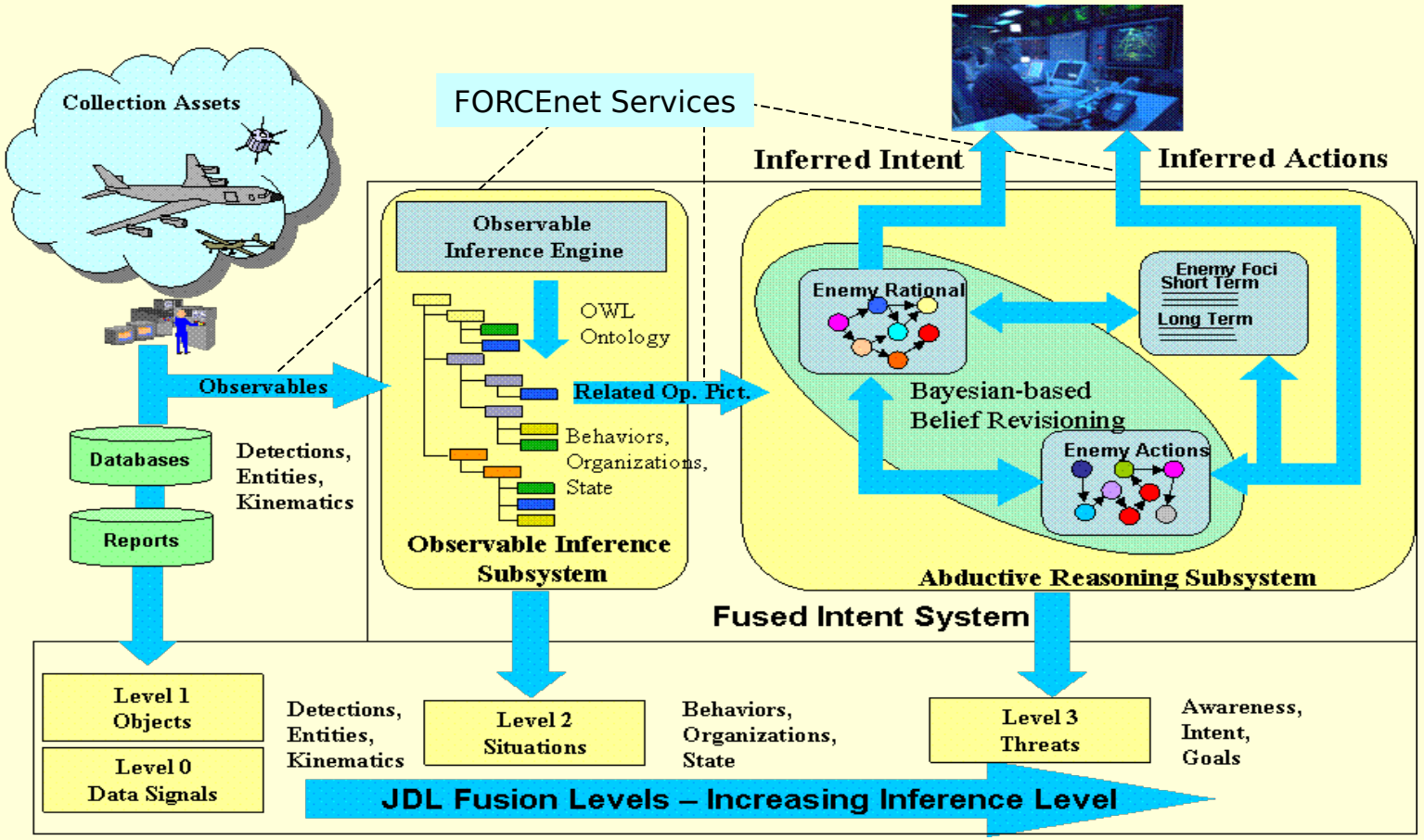
Impact/Payoff

- **FIS can be applied to a broad range of Intelligence Problems**
  - Original fictitious scenario focused on Iranian actions in the Straits of Hormuz
  - Currently developing open-source derived China-Taiwan scenario including historical and recent activities between China, Taiwan, and the US
- **Goal is to enable analysts and decision makers to understand the big picture behind events in their AOR**
  - Gain insight into why things happened
  - Predict what may happen next

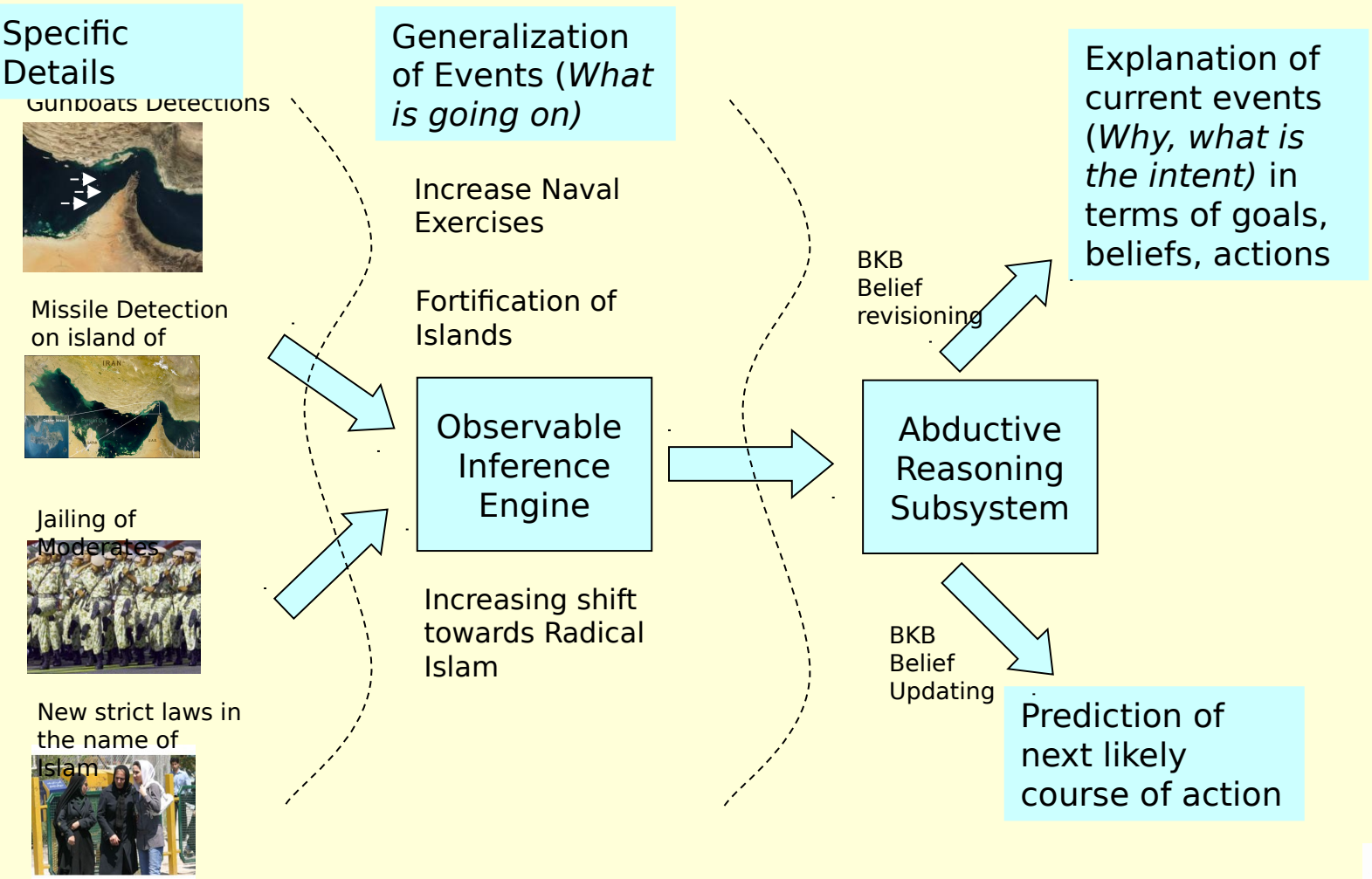
Operational Applications

- Indications and Warning
  - Set preconditions in model
  - Observe events in the operational environment/AOR
  - FIS infers next likely actions, impact of events
  - Example: Likelihood of Chinese invasion of Taiwan
- “What If” Analysis
  - Continuously updated model based on current events
  - Analysts input potential events
  - FIS infers impact of inputs and potential actions if those events has occurred
- Wargaming (future capability)
  - Continuously updated model based on current events
  - Planned Blue COA vs. most likely/dangerous Red COA
    - Potential for interaction with Blue & Red Systems Models
  - FIS infers impact of Blue actions on Red & Red actions on Blue

Architectural Overview



FIS Demonstration

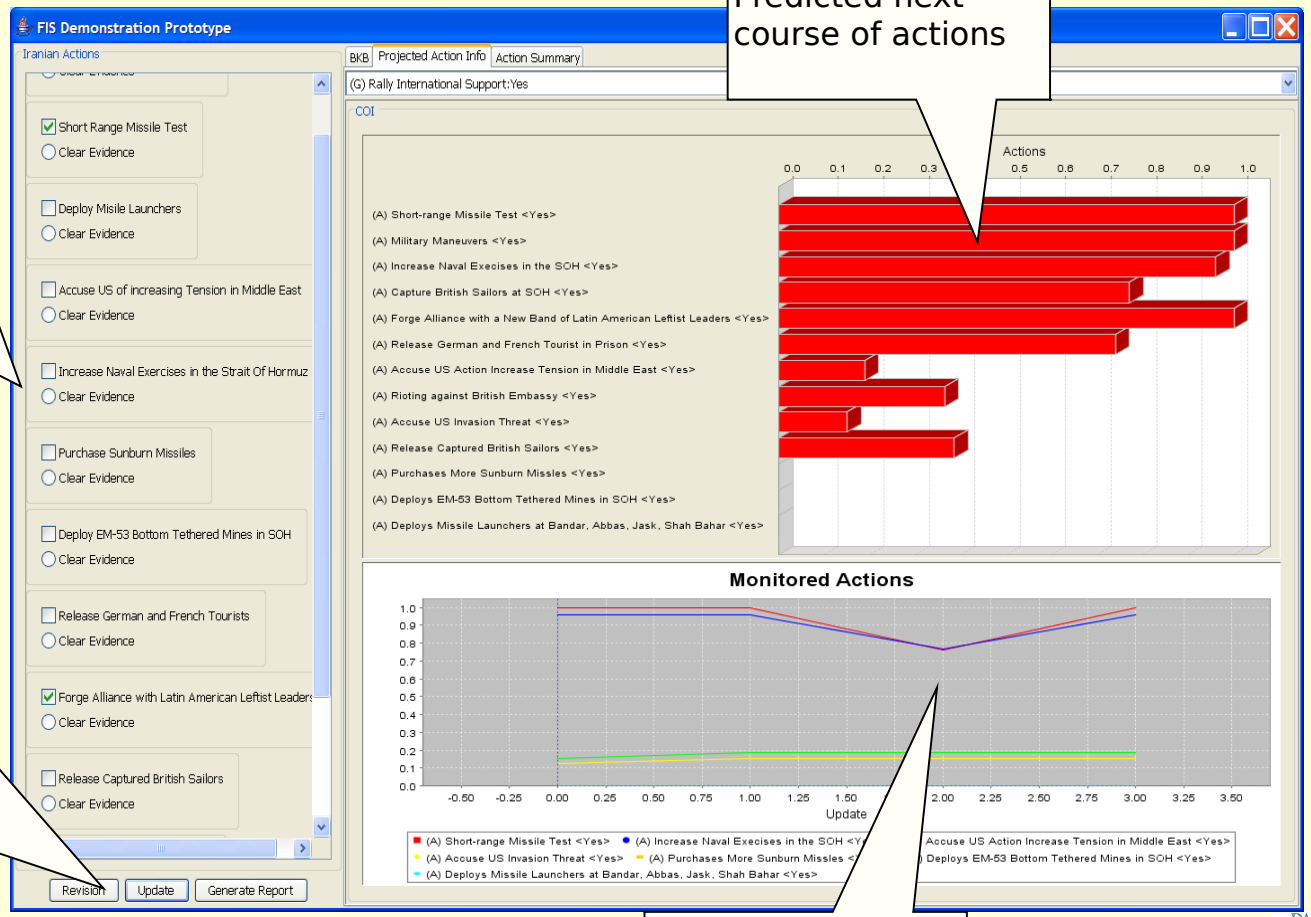


FIS Basic Flow

FIS Demonstration Platform

Generalized Observable Actions. User can turn on/off – performing 'what-if' scenarios. Ultimately this will be driven by from the OIS and supplemented by analyst

Predicted next course of actions



Revision-enter evidence, and generate report that explains the evidence. Update will predict next likely courses of action .

Trending charts for likelihood of actions

FIS Demonstration Platform

1 Set Evidence

2 Execute Revision (what explains the evidence)

Execute 'Update' Get next predicted Actions.

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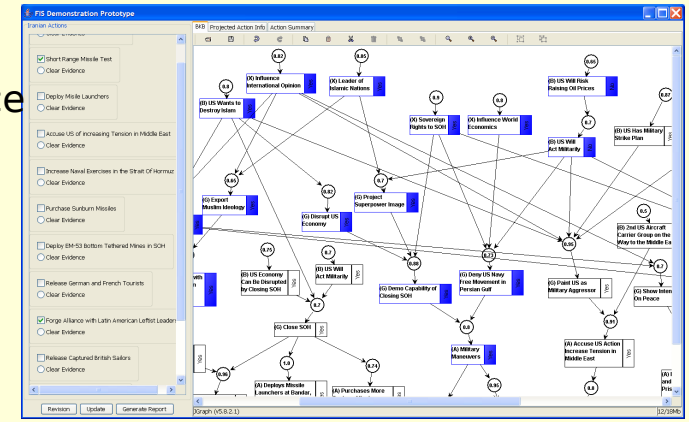
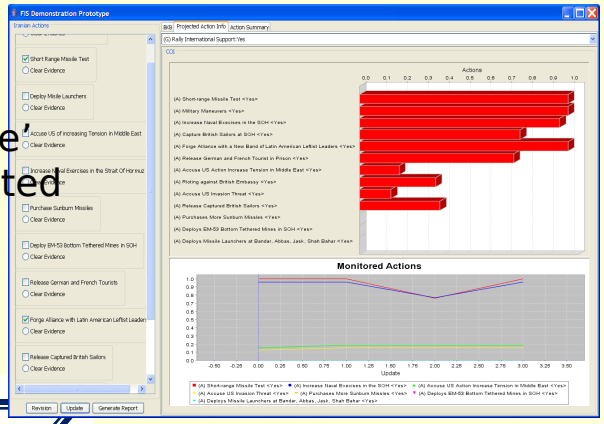
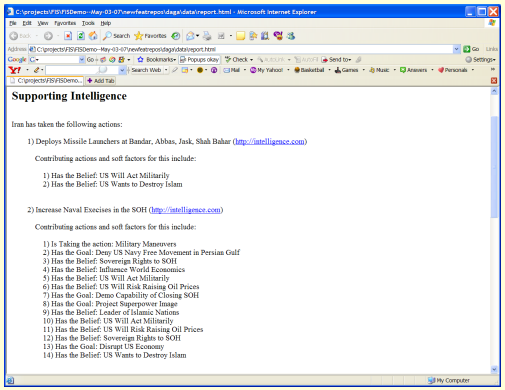
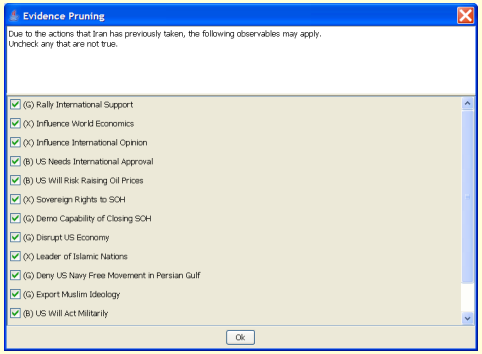




3 View Contributing Explanations



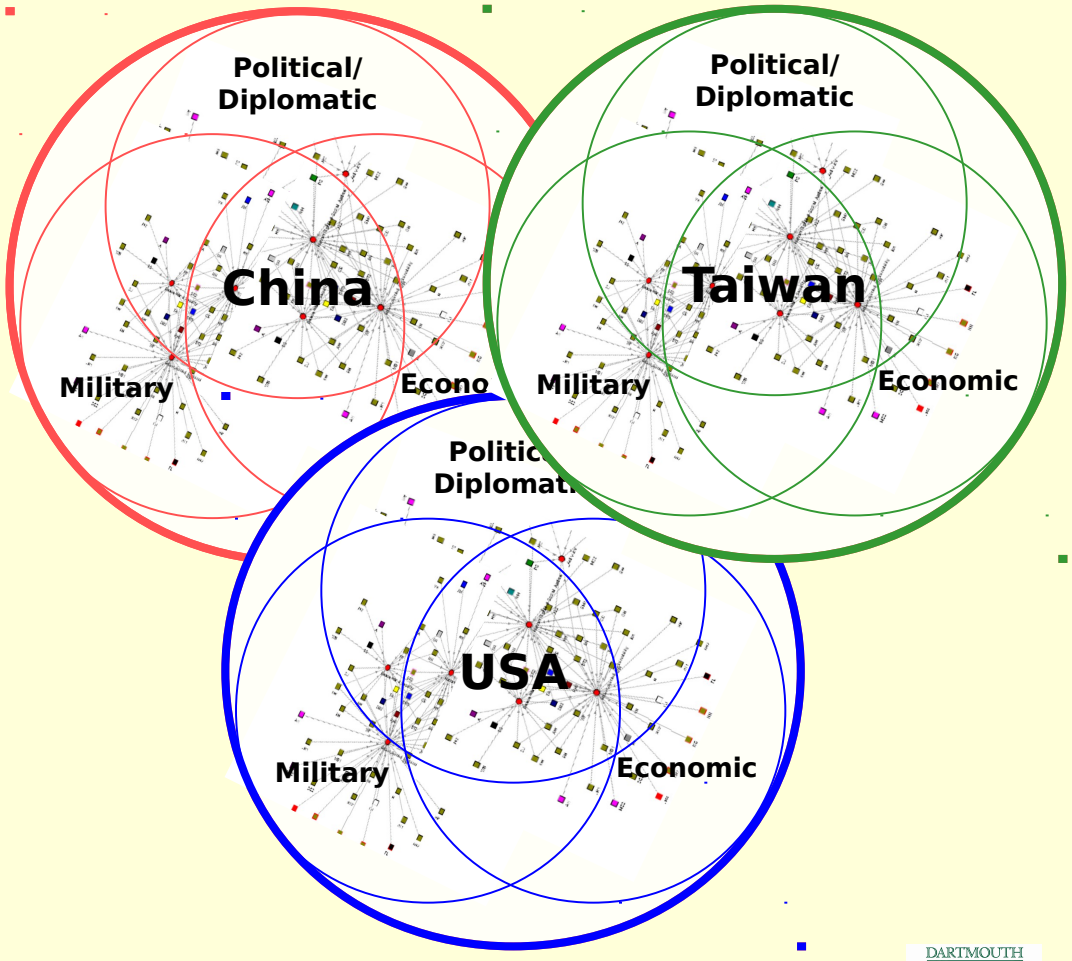
4 Generate Explanation Intel Report



5 Adjust / Supplement Evidence

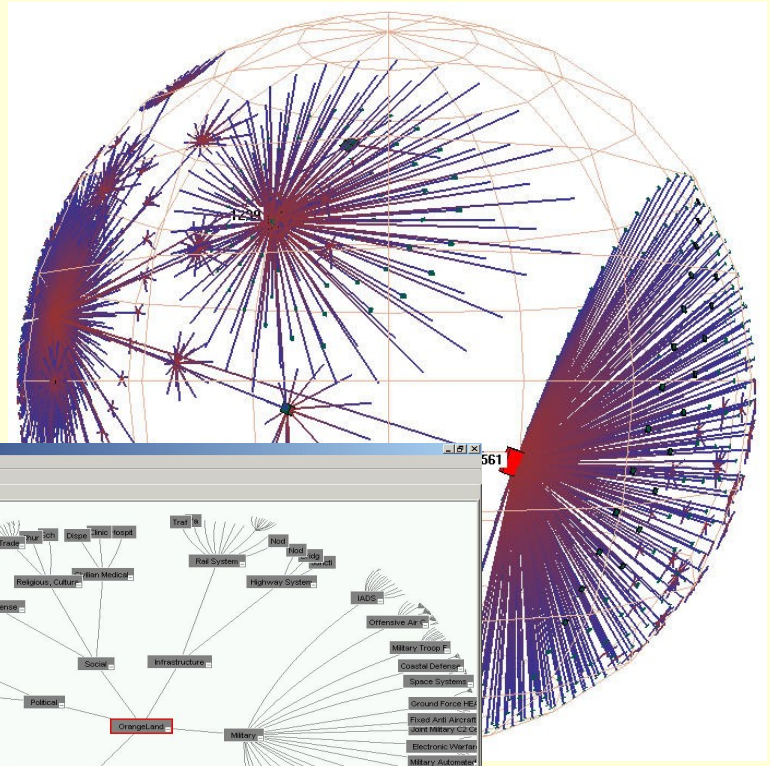
FIS Vision

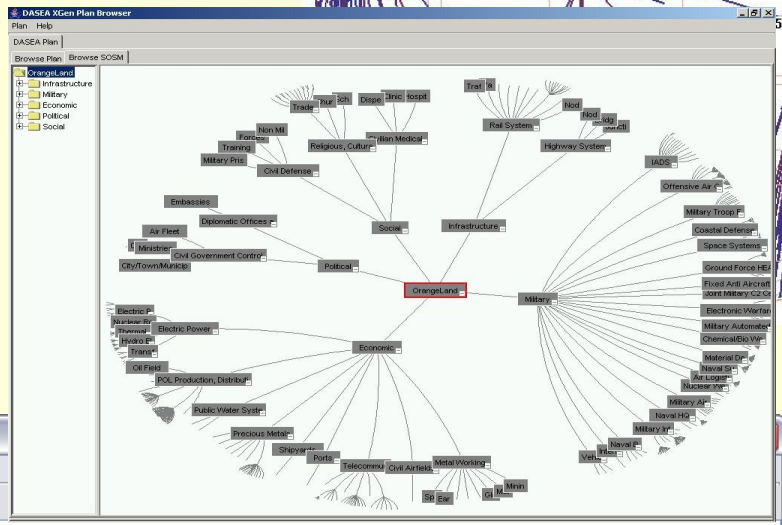
- Revolutionize intelligence analysis
  - Formal documentation of assumptions, facts, and inferences in a model-based rather than data-based system
  - Model-based system captures complex relationships and enables inferencing across multiple models

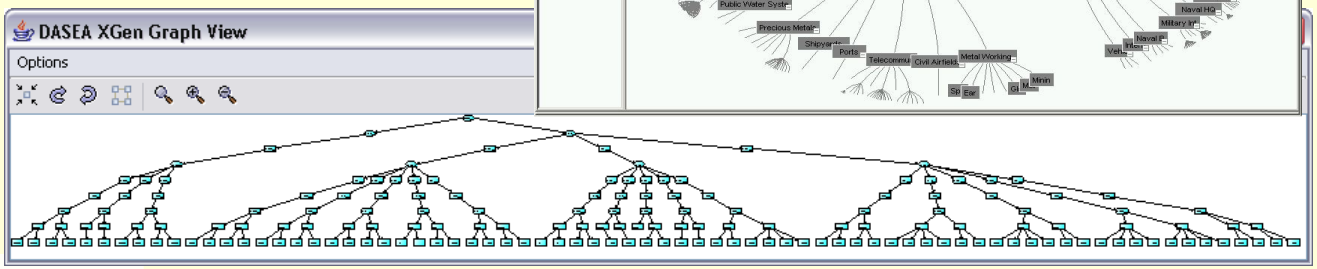


FIS Vision

- Customizable visualization of soft factor models
  - Enables analysts to search through complex models for relationships and nodes of interest—Google Earth for soft factors

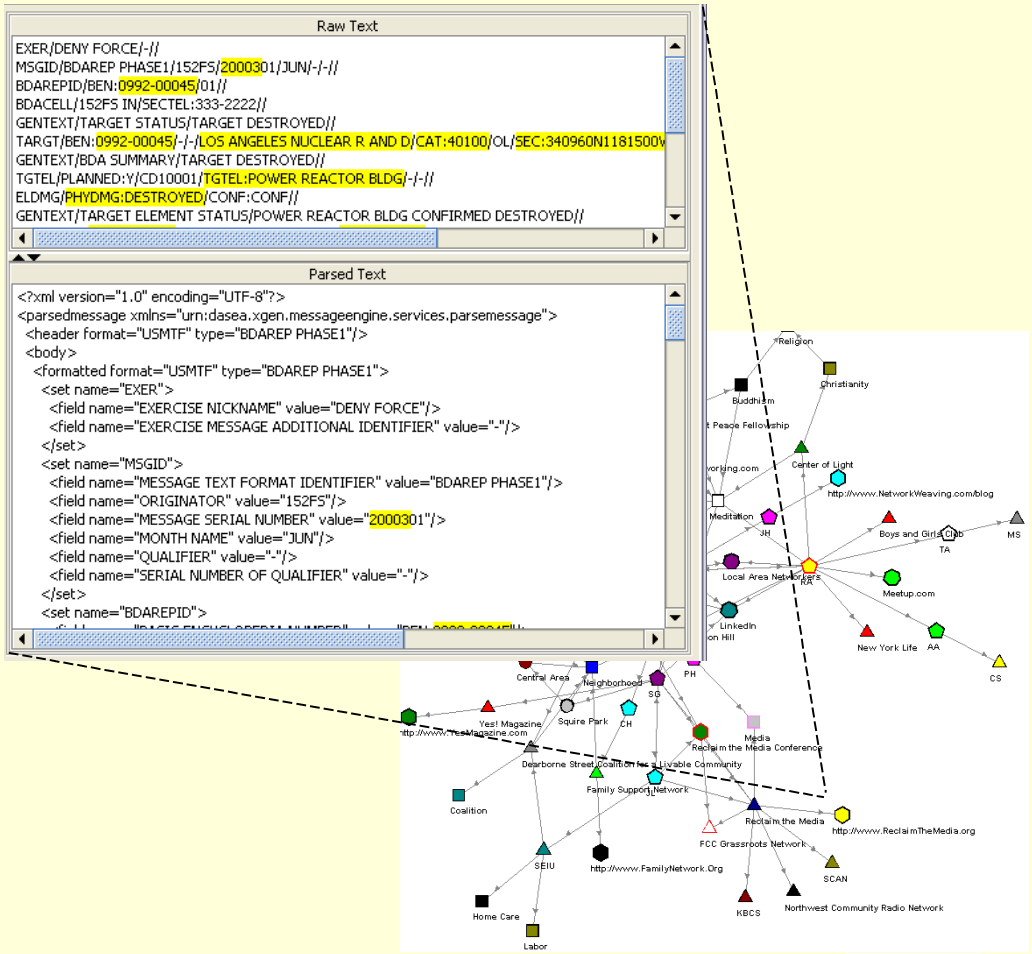






FIS Vision

- Auto-generated models from incoming data
  - Use advanced message parsing and data mining algorithms to automatically generate models for analyst verification
  - Huge time saving over manual systems of today



“Dynamic Adversarial Gaming Algorithm (DAGA)”

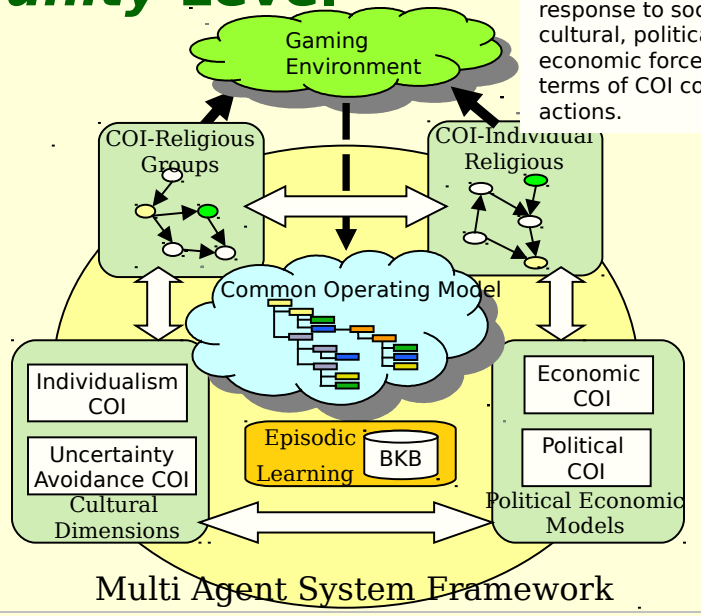
"Socio-Cultural Modeling to Enable Asymmetric Simulation - at the *Community* Level"

Dynamic Adversarial Gaming Algorithm (DAGA)

- **Develop algorithmic techniques to accurately predict Community of Interest (COI) response to social, cultural, political and economic actions.**
  - **–Enable predictions based not only on current situation and adversary capabilities, but also on adversary's cultural dimensions and 'soft-factors'.**
  - **–Use predictions to provide adaptive strategy selection in multi-cultural adversarial games and related simulations within the context of an agent-based dynamic adversarial environment.**

Securboration – Dartmouth Team

Prediction of COI response to social, cultural, political and economic forces in terms of COI course of actions.



Planned Demos/Deliverables/Transitions

Initial focus on Gaming with transition to areas such as

- **Asymmetric Threat Detection**
- **Mission Planning**
- **Counter-terrorism**

Fundamental capability of DAGA is to predict individuals or group response to social, cultural, political and economic actions

- **Homeland Security / Intelligence**
- **Potential acts of terrorist cells**

Significance and Warfighter Payoff

- **Provide real world adversarial behavior to the simulation community.**
- **Address the various elements, both internal and external, that influence adversary behavior and show their respective impacts on adversarial actions**
- **Supports the move away from doctrine based warfare on the part of an adversary towards more realistic asymmetric response**

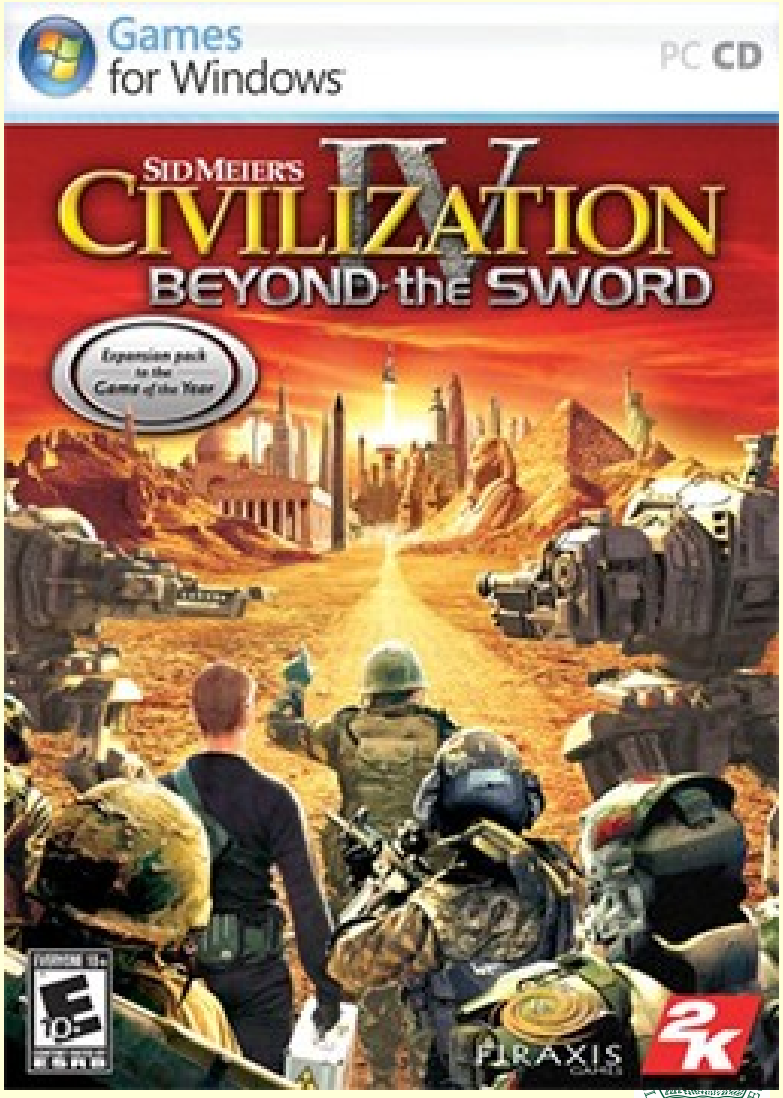
AFSOR Contract No. FA8750-05-C-0054

Dynamic Adversarial Gaming Algorithm (DAGA)

- Securboration, working with Dartmouth College researcher Dr. Eugene Santos Jr., is developing DAGA to support adaptive strategy selection in multi-cultural adversarial games and related simulations.
- Current emphasis is on integrating DAGA with existing gaming engines, such that DAGA provides realistic underlying primary behavior for asymmetric adversaries based on socio-cultural factors.

Game Integration

- To highlight DAGA's capabilities, we have integrated it with the popular *Civilization 4* (Civ4) game engine to demonstrate how the infusion of socio-cultural influences leads to a much more realistic asymmetric adversary.

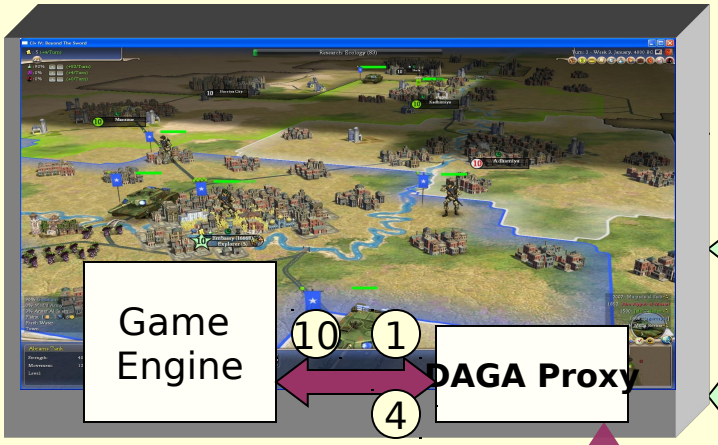


Game Scenario

- Developed scenario representative of the current political and military situation in Baghdad
  - "Players" include **Coalition Forces**, Iraqi Transitional Government, Mahdi Army, Al Qaeda in Iraq, and Ansar Al-Islam.
  - Each player is represented as a Community, with their own goals, actions, beliefs, and axioms which are modeled as Bayesian Knowledge Bases.
  - As the 'game' progresses, DAGA 'pulls' information from the gaming engine for use in its calculations, and 'pushes' results back to the gaming engine to dynamically modify the behavior each adversarial player.

Game Results

- The result is a game that now includes realistic asymmetric adversaries that act, and react to coalition actions, based on socio-cultural beliefs and other soft-factors.
  - Without DAGA, adversaries give up quickly because of overwhelming coalition force. With DAGA adversaries are more dynamic and continue to fight.



B

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DAGA Server

Evidence Manager

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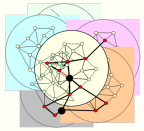
Bayesian Knowledge Bases



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Semantic Model

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Processed Ontology

Raw Ontology

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Rules

A. Scenario created by
   - Editing scenario in game engine.
   - Generating or modifying ontologies, BKBs, and rules.

B. User launches scenario via game engine.and starts playing scenario

1. Game Events and stat reports sent to DAGA Proxy.
2. Events and status reports sent to DAGAServer
3. Evidence Manager processes events and reports and adds them to RAW ontology
4. Game sends request for adversary actions prior to adversary's turn.
5. DAGA Proxy sends request to DAGA Server.
6. DAGA Server processes request and utilizes Semantic model to transform Raw Ontology into Processed Ontology
7. Evidence Manager requests Rules engine to "fire" and set evidence from Processed ontology on the BKBs.
8. BKBs are updated and next actions are generated for adversary
9. Evidence Manager processes actions and sends them to DAGA Proxy
10. DAGA Proxy sends next actions to game engine, where they are utilized by adversary.

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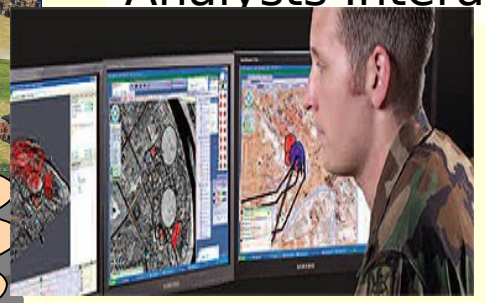
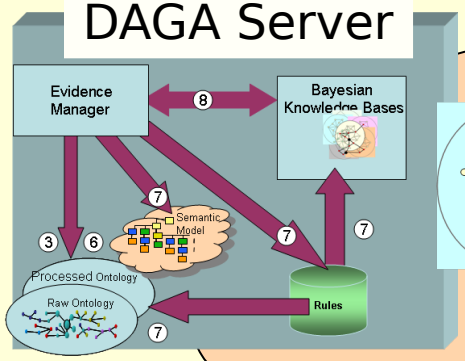
Simulation / Gaming Environment

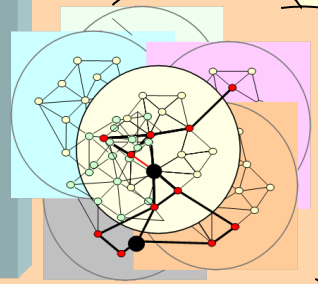
Analysts Interaction



Real-time assessment, shifts in underlying cultural values based on actions and influences, feeding real-time operational planning systems.

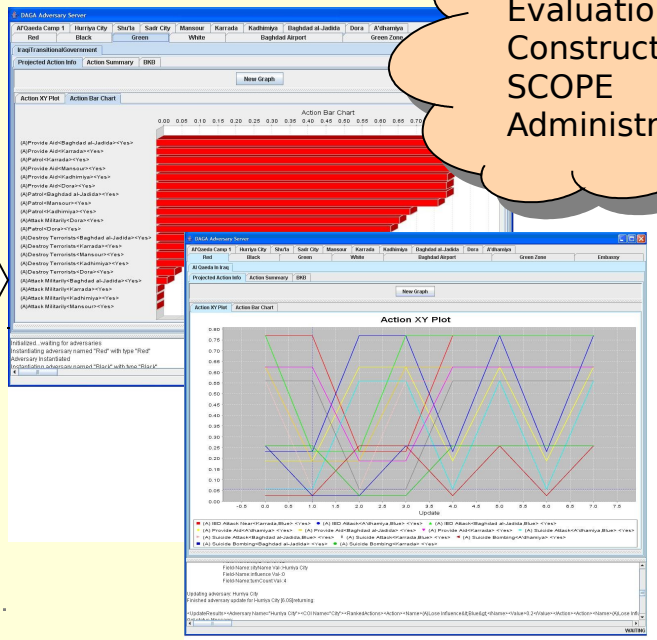
DAGA Server





DAGA Computational Model

Model Validation, Evaluation, Construction, SCOPE Administration



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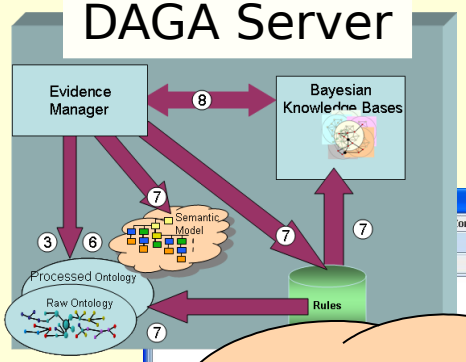
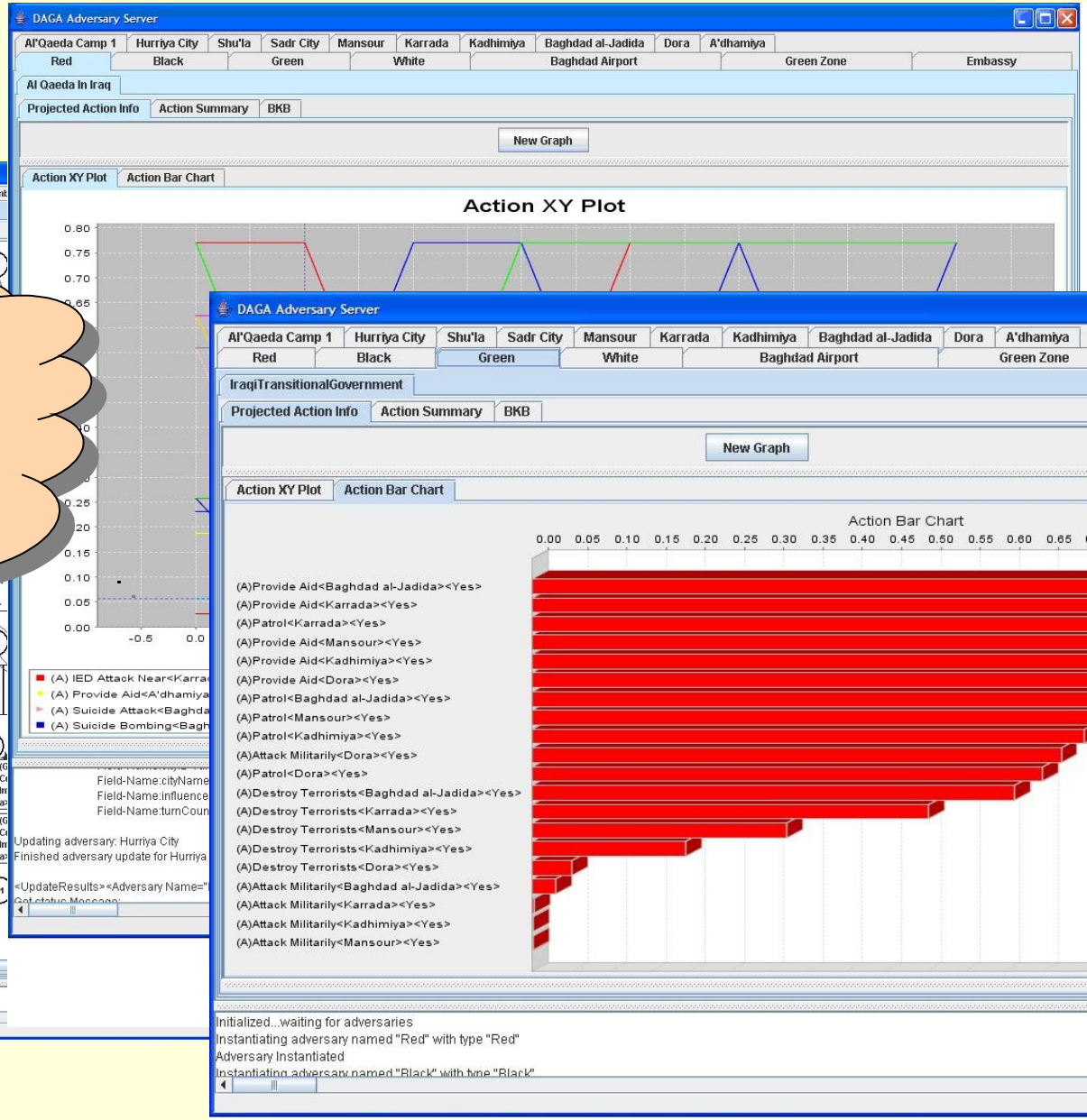
Groups of adversaries and neutrals being driven by DAGA – reacting to coalition actions based on the current game state and their goals, internal beliefs, external beliefs, and actions.


Civ IV: Beyond The Sword
: 5 (+4/Turn)
Research: Ecology (83)
Turn: 2 - Week 3, January, 4000 BC
:90% (+82/Turn)
:0% (+4/Turn)
:0% (+0/Turn)
Shula
Hurriya City
Kadhimiya
Mansour
Green Zone
Settler (8574)
Adhamiya
Sadr City
Embassy (16668)
Explorer (5)
Karrada
Dora
Baghdad al-Jadida
Infantry, 40 , 3
Fortify Bonus: 5%
0-1 First Strikes
+20% City Defense
93% Coalition
6% Ansar Al-Islam
Plains, 1 , 1 , 1
Fresh Water
2007: Muqtada al-Sadr
1852: Abu Ayyub al-Masari
1500: Jalal Talabani
1409: [sgorczyca]
1404: Mulla Krekar
Abrams Tank
Strength: 40
Movement: 12
Level: 1

DAGA Server



DAGA Server, Administration Consoles



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Questions ?

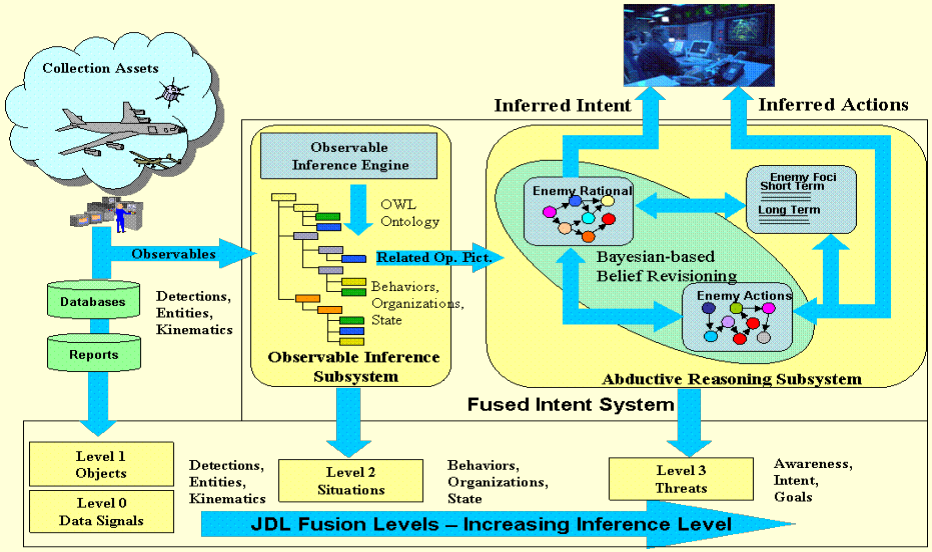
lkrause@Securboration.com

Make sure you see the Tool Demonstration

FIS Quad chart

Project Description & Approach

- Description: Provide capability within FORCENet to transform unactionable JDL level 0/1 data into actionable level 2/3 knowledge that enables the Warfighter to understand intent of the adversary - i.e. why the adversary is acting in a particular manner.
- Approach: Utilize ontological modeling and inference to classify events and abductive reasoning over observables and political, social, economic 'soft factors' to infer adversarial intent, motivations, and future actions.



Project Description & Approach

- **Spiral 1:** Initial model of soft factor interrelationships; validate interface from Ontology Inference Subsystem to Abductive Reasoning Subsystem; initial reasoning over integrated model of observables and soft factors.
- **Spiral 2:** FORCENet services for dynamic updates to adversarial model; Service publication in FORCENet; Increased scenario complexity.
- **Spiral 3:** Anticipated parallel demonstration with JEFX '08; Fleet transition.

Significance and Warfighter Payoff

- Support the Warfighter in understanding WHY the adversary is acting in a particular manner.
- Increase's the Warfighter's situational awareness by providing predictive understanding of most likely adversarial COAs based on:
  - Adversarial soft factors – goals, beliefs, rational.
  - Updates from FORCENet that enable abductive reasoning over a dynamic model of the adversary.

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